ALLOCATION OF ALEXANDER SPRINGS AMONG SCUBA DIVERS

by

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Abstract: Alexander Springs is located on the Seminole Ranger District of the Ocala National Forest in Lake County, Florida. It is the only first magnitude spring in the National Forest System. The springs themselves have been a prime attraction for local residents and visitors to central Florida for many years. It is a highly desireable place for swimming, scuba diving and for conducting open water scuba diving lessons.

The demand for the springs by individual scuba divers and diving classes has been steadily increasing over the last few years. The major concerns of the Forest Service in managing the use of the springs by scuba divers are safety, protection of the springs, and fairness in allowing access. Therefore, the specific objective of this project is to solve the problem of allocating the use of Alexander Springs by scuba divers among the many commercial scuba intruction classes and individual divers. Development of a method to manage that use while protecting the springs and at the same time be equitable to all scuba divers in scheduling their use of the springs is the goal of this project.

EXECUTIVE SUMMARY

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Summary

Alexander Springs is located on the Seminole Ranger District of the Ocala National Forest in Lake County, Florida. It is the only first magnitude spring in the National Forest System. The springs have been a prime attraction for local residents and visitors to central Florida for many years. It is a highly desireable place for swimming, scuba diving and for conducting open water scuba diving lessons.

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Information had to be obtained about the supply of suitable places to conduct open water scuba lessons and the demand for such places. It was also necessary to get information about the characteristics diving instructors look for in sites in which to conduct classes. This information was gathered through the use of a written survey mailed to the twenty six dive shops and instructors who had active special use authorizations to conduct classes at Alexander Springs in 1986.

Another aspect of allocating the use of the springs was to determine the "carrying capacity". That is, what is the maximum number of divers that

can be in the spring at one time? To do this the amount of aquatic environment was quantified by physical measurement of the primary area of the spring used by divers. The volume of the area was then calculated. Next the minimum amount of space a diver needs to dive safely and still maintain the quality of the experience was determined by consulting several experienced divers and instructors through direct conversation and discussion. Then the total volume of the spring was divided by the volume needed by each diver to arrive at the maximum number of divers that should be in the spring at one time.

Pricing, queueing, random selection, and reservation are evaluated as four alternative methods of allocating limited resources to excessive demand.

Twelve of the twenty six surveys that were mailed out were returned. Of the twenty two diving sites listed by the respondents, ten are springs. The two most popular and heavily used sites are Alexander Springs and King Springs.

Quality of the water is the most important factor in selecting a place to conduct scuba classes or to pleasure dive. The next most important factor is reliability of access. The other characteristics in order of descending importance are proximity, convenience, aesthetics, fees, facilities, and other miscellaneous factors.

Most instructors perceive that the supply of good places to conduct scuba lessons is decreasing. Most instructors also perceive that the demand for good scuba instruction sites is increasing.

It is estimated that a total of 3785 students are receiving open water instruction at Alexander Springs in one year.

Physical measurement of the primary area of Alexander Springs yielded a volume of 70,650 cubic feet. The average minimum volume that should be allowed for each diver is 1728 cubic feet. Dividing 70,650 cubic feet by 1728 cubic feet/diver allows 41 divers to be in the water at one time. Classes require an area of about 155 square feet. There is enough space for three open water classes to be conducted at one time.

A system of allocation based on the supply of aquatic habitat is proposed using reservations and user fees.

INTRODUCTION

Alexander Springs is located on the Seminole Ranger District of the Ocala National Forest in Lake County, Florida. It is the only first magnitude spring in the National Forest System. The spring and the river it forms has been designated by the State of Florida as an Outstanding Florida Water. This provides special status and protection to the springs and river and sets limits on the activities which take place on the river. The springs themselves have been a prime attraction for local residents and visitors to central Florida for many years. Developments around the springs include a campground with 67 sites, bathhouses, concession stand, picnic tables, grills, sand swimming beach, canoe rentals, and an interpretive nature trail. The day-use area immediately adjacent to the springs has a capacity of 470 people at one time (PAOT).

The main spring produces an average of 80,000,000 gallons of water per day. The quality of the water is superb. The temperature is in the range of 72 - 74 degrees Fahrenheit all year. The primary boil is 25 to 30 feet deep and 50 to 60 feet in diameter. It is a highly desireable place for swimming, scuba diving and for conducting open water scuba diving lessons.

The case of Alexander Springs is one example of the phenomenon discussed by Garret Hardin (1968) in his article *The Tragedy of the Commons*. That is that when everyone owns, has unlimited access to, and is entitled to use a resource, it leads to the destruction of the resource assuming each person pursues their own interest in using the resource. As Hardin points out, there is no technological solution to this problem. The problem is even greater when the resource is not renewable as is the case with Alexander Springs.

The demand for the springs by individual scuba divers and diving classes has been steadily increasing over the last few years. This is just part of the larger trend in noncompetitive outdoor personal-growth activities such as canoeing, backpacking, rock climbing, and bicycle touring. There are many factors which have contributed to the growth in the diving industry. Among these are the development of sophisticated teaching systems, good instructors, lighter and more colorful equipment, and affordable travel to exotic diving destinations (Wohlers, 1987). These and other factors are the reasons for the annual growth rate of 51.1 percent in the number of people who learned to dive between 1975 and 1983. Over 350,000 students in the United States were certified in 1985 (Wohlers, 1987).

In managing the use of Alexander Springs we are not dealing with a varying quantity of the resource nor is it a renewable resource. In this case we have a fixed amount of the resource which must be distributed among increasing demand. It is important at this point that it is made clear exactly what the resource is. It is not the water which flows from the springs, although it is crucial to the existence of what scuba divers come for. The resource we are dealing with is an aquatic environment of exceptional quality. Open water diving instruction must have very clear water, minimal currents and turbulence, and truly be open water. Aquatic environments which provide these conditions are few and far between and people are willing to travel long distances for them.

The major concerns of the Forest Service in managing the use of the springs by scuba divers are safety, protection of the springs, and fairness in allowing access. Therefore, the specific objective of this project is to solve the problem of allocating the use of Alexander Springs by scuba divers among the many commercial scuba instruction classes and individual divers. Development of a method to manage that use while protecting the springs and at the same time be equitable to all scuba divers in scheduling their use of the springs is the goal of this project.

The objectives of the project are:

1. Present a review of the literature which addresses the problem of allocating limited resources to exessive demand.

2. Present alternative methods of resource allocation.

3. Evaluate past and present demand by scuba divers and estimate future demand.

4. Determine the method of allocation which is best suited to the situation at Alexander Springs.

5. Develop and recommend a system for managing the use of Alexander Springs by scuba divers and an action plan to implement the system.

LITERATURE REVIEW

A great deal of research has been done in the United States and around the world in the field of allocating resources. The literature reviewed for this project was selected through a computer search conducted by Southfornet, the U.S. Forest Service's library service based at the University of Georgia at Athens, Georgia.

Interestingly, considerable research has been conducted into the economics of research itself. Several publications that were reviewed dealt with the allocation of resources (people, money, and physical resources) to research, especialy agricultural research (Tweeten, 1969; Shumway, 1973; Shumway, 1977; Shumway, Talpaz, & Beattie, 1977; and Makower, 1975).

Computers have played an important role in the research of allocating resources. One particularly widespread application is the Resources Allocation Method (RAM). This method employs linear programming and has been adapted to different resources around the world. In the United States Timber RAM is used by the U.S. Forest Service in the west and utilizes a linear programming package known as "MPSX" (Tedder, Kletke, & Weaver, 1978). Field (1978) enhanced the linear programming of Timber RAM by using goal programming. In Taiwan, the use of Timber RAM has been

investigated as a method of long-term management planning of forest resources (Yang, Lin, Chen, & Wang, 1980). Another adaptation of RAM has been made in the area of range management where it has been used as a long-term method for managing grazing lands (Jansen, 1976). Howard (1975) reported on a hierarchy of three computer models used to make multi-objective allocation of water in the Cedar River in western Washington. One is a high speed linear programming model used to allocate releases of water from two reservoirs. The second is a computer simulation model of the Cedar River and provides more detailed analysis of trial policies. The third is a closed form mathematical model used to estimate minimum water requirements for spawning salmon. This paper was unique in that Howard pointed out the short comings of this particular system of computer models after four years of work on them. In the conclusion of the paper he said that it would be unreal to claim that these models provided anything more than a marginal capability to improve the utilization of the water of the Cedar River. He also stated that the analytical questions that can be answered by modelling are few and that the results of modelling are often obvious.

Other publications dealt with a wide variety of issues related to allocating resources. Putterman (1981) discussed the optimality in the way land is allocated on

the one hand to the collective use by communities and on the other to the private use by members of the communities. Ferguson (1979) proposed a new method, an adaptation of the strategic-choice approach, to providing informal recreation opportunities in the English countryside. The basic steps of his approach are 1) the problem focus (i.e. "How to allocate resources for informal coutnryside recreation among a given group of sites."), 2) formulation of realistic alternative management strategies, 3) evaluation of management strategies and 4) proposals, the translation of the chosen strategy into a package of commitments. Roefs and Kimball (1976) reviewed the basic structure of the Techcom planning method. This is a planning method used to quantify societal goals so as to provide useful information to decision makers. The method was developed by the technical committee of the water resource centers of the thirteen western states in response to the increasing demand for multi-objective planning in water resources development. Milon (1981) focused attention on the ethical basis for evaluating alternative non-market goods allocations. De Gier (1985) dealt with a method for identifying the levels of competition between population centers whose inhabitants collect a scarce resource. In his example the scarce resource was fuel wood. The principle of the method was a way to quantify 1) supply in terms of a) the amount of fuel wood available, b) fuel wood need per person and 2) demand in terms of a) the number of

fuel wood collecting people and b) the maximum distance people travel to collect wood. Fractor (1982) evaluated alternatives for rationing the use of wilderness areas. The alternative methods he reviewed were 1) rationing by price, 2) rationing by queue, 3) rationing by random selection, and 4) rationing by reservation. He concluded that rationing by price maximizes social benefit.

METHODOLOGY

The literature dealing with the allocation of resources demonstrates that there are many intricate schemes to accomplish the task at hand. Each approach is, in some way, unique to the specific situation to which it is applied. The computer modeling approach takes a great deal of time and research to develop the necessary information from which a reasonable model can be built. As Howard (1975) pointed out, even after years of work, little may be gained. Given the constraints on time and resources of this project the use of computer models was ruled out. It is questionable if such an approach would be economically justified in this situation.

Supply and Demand

To get a broader understanding of the scuba instruction industry in Central Florida, information had to be obtained about the supply of suitable places to conduct open water scuba lessons and the demand for such places. It was also necessary to get information about the characteristics diving instructors look for in sites in which to conduct classes. The basic questions of what, where, when, and why had to be answered. This information was gathered through the use of a written survey (Appendix A) mailed to the twenty six dive shops and instructors who

had active special use authorizations to conduct classes at Alexander Springs in 1986.

Item one of the survey asked for the sites used most frequently for conducting lessons. The purpose was to ascertain which scuba diving sites are being used most frequently by the instructors who used Alexander Springs. The results were interpreted by counting the number of respondents who used each site.

The purpose of item two of the survey was to find out what characteristics or qualities of the sites given in item one made them attractive for diving. Participants in the survey were asked to rate eight characteristics with the most important one rated with a "1" and the least important with an "8". To interpret the results, a weighting factor was given to each characteristic. A score for each characteristic was then calculated by summing the products of the weighting factor and the number of respondents that gave the characteristic the same rating. A weighting factor was used so that the most important factor would have the highest score. For example, if two respondents indicated that water quality was the most important characteristic, a weighting factor of "8" was multiplied by two. This was done for each rating that water quality received and then all the products were added up to get the score for water quality. This procedure was used for each characteristic and then they were ranked. In

general, this item explains why divers choose the sites they do.

Items three and four of the survey were designed to ascertain when the greatest demand occurs. Item three is on a seasonal basis and item four is on a weekly basis. The data from item three were used by multiplying the number of classes by the number of students in each class to get the total number of students for each instructor for each season. Then the number of classes were totaled and the number of students were totaled and used as an index of demand. The results of item four were so consistent that it was very clear that open water classes almost always are conducted on Saturday and Sunday.

The purpose of items five and six was to get an indication of how the instructors perceived the trends in supply and demand for diving sites. The results were interpreted by counting the number of respondents that selected each trend.

The Supply of Alexander Springs

Another aspect of allocating the use of the springs was to determine the "carrying capacity". That is, what is the maximum number of divers that can be in the spring at one time without damaging the spring itself or diminishing the safety and the quality of the diving experience for

divers or the experience of other swimmers? To answer this question a method of quantifying the amount of aquatic environment was needed. This was done by physical measurement of the primary area of the spring used by divers. The volume of the area was then calculated. Once it was known how much aquatic habitat there is, the minimum amount of space a diver needs to dive safely and still maintain the quality of the experience had to be determined. To do this, several experienced divers and instructors were consulted through direct conversation and discussion. After determining the volume of the spring and how much a diver needs, it is a simple matter of dividing the total volume of the spring by the volume needed by each diver to arrive at the maximum number of divers that should be in the spring at one time.

ALTERNATIVE METHODS OF ALLOCATION

Many of the problems dealt with in the literature are not similar enough in their situation and circumstances to be applied to Alexander Springs . The resource which has the most in common with Alexander Springs when considering the task of allocation is wilderness. First of all, both are non-renewable. The size of the basin of the main spring cannot change. Assuming the water level remains fairly constant, this provides the same limited amount of aquatic habitat all the time. So it is with wilderness, as there are only so many acres of wilderness habitat. In each case the resource is dynamic. In the spring there is flowing water, changing aquatic plants and animals. In the wilderness there are changes in the species composition of the plant and animal communities. Each environment has well defined boundaries and to some extent, access can be controlled. Finally, the quality of the experience a person has in each of the two environments decreases as the number of people in each one increases. And so it is the paper by David Fractor (1982) which offers the most reasonable alternatives to rationing the use of these resources.

Fractor (1982) compared four methods of rationing: rationing by price; rationing by queue; rationing by random selection; and rationing by reservations. To make direct

comparisons between these methods the social benefits as measured in dollars or time were compared. To do this it was assumed that time for all users has a common value, an assumption which in reality is probably incorrect. However, it is still generally true that the users who are willing to pay the most are also the ones who are willing to wait the longest to use the resource.

In Fractor's analysis, social benefit is defined in dollars as the benefit gained by society as the result of voluntarily making the resource accessible to the public. The two components of social benefit are the benefit to the users of the resource (referred to as consumer surplus) and the benefit received by the owner of the resource (referred to as producer or owner surplus). Using these concepts, formulas for supply, demand, and the equilibrium between supply and demand are derived. Using this approach, dollars can be used as the common measurement of the value placed on the resource by the users and of the cost of providing the resource by the owner through the different rationing methods. Social benefit is greatest when the sum of the consumer surplus and producer surplus is the greatest.

Rationing by Price

Price is probably the most familiar method of rationing anything in our society. Pricing brings the level of demand down to the level of supply by increasing the cost of using the resource. It's application to the rationing of a natural resource like wilderness or a spring has strong points and weak points. What must be kept in mind is that under any method of allocating a scarce resource the use by one person necessarily excludes someone else from using it.

Fractor found through his analysis that rationing by price provided the greatest social benefit of the four alternatives he considered. The single greatest advantage of the pricing alternative is that it could raise a lot of money. Then any number of things could be done with it, such as helping to maintain the resource, acquiring more of the resource or the money raised could be used to subsidize the use of the resource by those who could not afford the price of admission. Fractor said that through the use of pricing the availability of the resource would be allocated to those who value it the most. I disagree with this idea. The truer statement is that the resource would be allocated to those who are able to pay the most. Financial capability is not the same as being willing to pay and not being able. The point is that there are many people who

live some distance from a resource they value very much but are unable to pay for the transportation to get to the resource or they are even physically unable to experience it. The greatest disadvantage in rationing access to users who are able to pay the most is the elimination of the opportunity to use the resource by those who cannot pay.

Rationing by Queue

This alternative method of allocation requires that users line up and wait their turn to use the resource. The limiting factor here is that eventually the time spent waiting in line becomes so great that people stop waiting in line. This is the point at which the supply and demand reach equilibrium.

Rationing by Random Selection

Another word for random selection is lottery. Using this alternative, the supply is allocated to users such that everyone has an equal chance of being satisfied. The biggest disadvantage of this method is the cost of operating the lottery.

Rationing by Reservation

Rationing by reservation in essence replaces a physical queue with a figurative queue. However, it differs in that it requires the users to make plans well in advance in order to enter the queue. It also differs in that the slots in the figurative queue of this approach do not necessarily fill up in sequence as they do in a physical queue (i.e. people going to the end of the line). When reservations are made openings are filled in the order in wh ch they are requested.

RESULTS

Twelve of the twenty six surveys that were mailed out were returned. Most were filled out correctly but some were not. The tables in Appendix B present the results of the survey. Data were included in the tables only if the respondents answered the questions in the format requested. Therefore, Table 2, which shows the information requested by item two of the survey, only shows the information from the eight respondents which provided it as it was asked for.

Supply and Demand

Table 1 presents the data from item one of the survey. Of the twenty two sites listed, ten are springs. The two most popular and heavily used sites are Alexander Springs and King Springs (headwaters of the Crystal River).

Table 2 of Appendix B deals with why these sites are the most frequently used. It is not surprising that the quality of the water is the most important factor in selecting a place to conduct scuba classes or to pleasure dive. The next most important factor is reliability. When a business needs to operate in a place which is not owned

or controlled by the business, there is an increased element of risk. Scuba instruction operates this way. Consequently, being assured that a scuba class will have access to a good place to dive is important.

The other characteristics in order of descending importance are proximity, convenience, aesthetics, fees, facilities, and other miscellaneous factors. As shown in Tables 1 and 2, most people prefer to use sites that are relatively nearby and to which they know they can gain access. However, some travel considerable distances in order to have a high quality diving experience.

Table 3 shows that most instructors perceive that the supply of good places to conduct scuba lessons is decreasing. In fact, this is the case. In the last year Homosassa Springs was closed to the public by the Citrus County Commissioners. Also, there is a growing debate in Florida over which bodies of water are owned by the state and which are not. Table 3 also shows that most instructors perceive that the demands for good scuba instruction sites is increasing. This too is based in fact as discussed in the introduction of this paper.

Table 4 of Appendix B presents the data acquired from item three of the survey. The numbers in the columns labeled "C" represent the average number of classes

conducted by each dive shop or instructor per month. The numbers in the columns labeled "S" represent the average number of students in each class. The numbers in the columns labeled "T" represent the average number of students taught in a month by each shop or instructor. The "T" column in the GRAND TOTAL line of the table, is the estimate of the total students taught each month by these instructors in each season of the year. By adding these numbers and multiplying by 3 months per season it is estimated that these ten instructors teach and certify 2877 students each year.

All these students do not receive their open water instruction at Alexander Springs. Only 38% (10 out of 26) of the surveys mailed out could be tallied in Table 4. Let's assume that half of the classes conducted by the holders of special use authorizations are held at Alexander Springs. Based on the information in Table 4, we would estimate a total of 3785 [(1.0/0.38)(2877)(0.5)] students are receiving open water instruction at Alexander Springs in one year. Assuming that all classes are held on Saturdays and Sundays there are 104 days [(52)(2)] on which classes are held. Dividing 3785 by 104 gives an average of 36 students being taught every Saturday and Sunday all year.

To take this a step further to be more accurate, the

distribution can be proportioned by season. During the period from January to March, 16.4% or 621 students are taught. Again, assuming classes are taught only on Saturdays and Sundays, an average of 24 students per day are taught. During the period from April to June, 26.4% or 1,037 students are taught. This would be an average of 40 students being taught each day on Saturdays and Sundays. During the period from July to September, 37.2% or 1,408 students are taught. Once again, assuming classes are taught only on Saturdays and Sundays, an average of 54 students per day are taught. Finally, during the period from October to December, 19.6% or 742 students are taught. This would be an average of 28 students being taught each day on Saturdays and Sundays.

The Supply of Alexander Springs

Physical measurement of the primary area of Alexander Springs yielded the following data: average depth of the main boil area is 25 feet; the average diameter of the area of primary use is 60 feet. Using these values in the formula for the volume of a cylinder yields the following:

Vol. = (3.14)(25 ft.)(30 ft.)(30 ft.) = 70,650 cubic feet.

After having consulted with several diving instructors and having been snorkling in Alexander Springs while open water classes were being conducted, I have concluded that the average minimum volume that should be allowed for each diver is 1728 cubic feet, the volume of a cube 12 X 12 X 12. Dividing 70,650 cubic feet by 1728 cubic feet/diver allows 41 divers to be in the water at one time. This would provide for an average distance between divers of 12 feet. However, it must be remembered that scuba diving is a dynamic activity and that the actual distance between divers will vary greatly. It must also be recognized that during open water classes divers must be within just a few feet of each other to practice the skills studied in classroom and pool sessions. During pleasure diving, divers may be considerably more than 12 feet from each other. Some pleasure divers may not be in the primary area of use as they explore the perimeter of the swimming area and observe aquatic plants and animals. I have observed the condition of the water as the number of divers increases. More divers stir up more sediment and drastically reduce the clarity of the water and visibility. Water quality is the most important factor that affects the diving experience.

The number of students an instructor may have in an open water class is eight. Ten students are allowed if a

certified assistant is present. These standards are set by the Professional Association of Diving Instructors. During an open water session, students and instructor dive to the bottom of the springs where skills such as communication, bouyancy control, and mask clearing are practiced. These activities are performed while the group is together in a circle with participants facing the center of the circle. This activity occupies an area of approximately 155 square feet (based on a circle with a radius of 7 feet). Given the shape and area of the bottom, there is enough space for three open water classes to be conducted at one time without getting in each others' way.

DISCUSSION

In each of the four alternatives presented, there are some underlying assumptions. First, it is assumed that the demand for the resource exceeds the supply. If this is not the case then there is no need for a method of allocation. Second, it is assumed that the supply of the resource is finite. The third assumption is that the limit of the supply is known and can be quantified.

The effect of each of the methods presented is to reduce the demand from a level which exceeds the supply to a level which is equal to the supply. The pricing approach does this by eliminating users who do not have enough money or are not willing to pay as much as others who can and will pay more. Even though this may yield the greatest social benefit from a strictly economic perspective, as Fractor concluded, there are other considerations which must be made. The pricing policy of the Forest Service for its campgrounds and recreation areas is to set user fees at a level comparable to fees of similar facilities in the private sector. Fees for Forest Service facilities should not be so low that they unfairly compete with the private sector. Yet the fees should not be so high that they prevent use of the areas by the general public. A system of allocation based only on price is not appropriate for National Forest fee areas.

Rationing by queue is not a very practical method for a situation like Alexander Springs. The second and third assumptions previously mentioned come into play here. The landscape architects who designed Alexander Springs used the size of the parking lot as the means of defining the supply of the day-use and swimming area. The lot has 125 spaces. When the lot is full the gate is closed and no more people are allowed to enter until someone leaves. Individual scuba divers and members of diving classes are included in this limit provided by the parking lot. Even if a class has made reservations, if the parking lot is full they are not allowed to enter. Consequently, most classes arrive early and are waiting at the gate when it opens at 8:00 a.m. On busy days when the lot fills up by 9:00 or 9:30 a.m., people continue to arrive at the gate. However, because there is no place for them to wait they are turned away and asked to come back when there is not such a large crowd.

The random selection or lottery method has an appeal to the sense of fair play. Everyone who enters the lottery has an equal chance of winning. The problem in applying this approach to the use of Alexander Springs by the scuba diving community is the cost of operating the lottery. Suppose the lottery was held to allocate the use of the springs for a year at a time. Two lotteries would have to

be held, one for individual divers and one for instructors who want to teach classes. To maintain the fairness of this system every person who would ever want to dive in the springs during the year would have to be given the opportunity to throw their name in the hat. Even though everyone has an equal probability of being selected, it doesn't necessarily mean that everyone will be selected. There is an element of risk involved that some people will not be selected at all while others get more than their share. Finally, given the number of divers and instructors there are, it becomes even more apparent why this approach is not feasible.

The use of reservations is the method which is presently being used to schedule scuba classes. Individual divers are not required to make reservations but instructors with classes are. No pre-arranged schedule is used so instructors call no more than two weeks in advance to make their reservation. Appendix C shows the details of the present system. For the most part this has been successful. However, there are shortcomings which usually stem from people taking advantage of the system. From time to time instructors make reservations and do not keep them. Sometimes the opposite occurs and classes show up without reservations. Some instructors make reservations for the maximum number of students and then show up with fewer students than what they reserved space for. They do this

to have the springs all to themselves and thereby unfairly keep other classes out.

The reservation system is not uncommon in allocating natural resources. It is used in wilderness areas in the west and is used in allocating the use of rivers by commercial outfitter/guides. The Chatooga River is a National Wild and Scenic River which requires management of its use to ensure a quality wilderness experience. In the case of the Chatooga River an operating plan was developed for the three companies which use the river the most for white water rafting trips. In developing the plan the Forest Service worked with these groups to schedule the specific times and places they would use the river. This approach was necessary because there was such an excessive demand on the river. The use of a planned schedule for the companies was possible because there were only three to deal with. Using a pre-planned schedule is not feasible with a large number of users (diving instructors) because of the unpredictable nature of some of their class sizes and when they decide to use the springs over some other site.

Fractor (1982) pointed out that with reservations "...it is impossible to state a priori what the sum of benefits will be.". New assumptions about peoples behavior must be made. If the people who are most willing to pay

are the ones who make their reservations the earliest then the marginal benefit curve will be very similar to that of the demand curve when price is the means used to allocate the resource.

The crux of the situation at Alexander Springs is that demand does not exceed supply all of the time. Use is seasonal and visitation is variable. Therefore, the assumption that demand exceeds supply is not true all of the time but only during certain periods of the year. This gives rise to the idea that a means of rationing is needed only at those times when demand rises above the supply. However, this is not practical. We know from past experience and from Table 4 in Appendix B when the periods of greatest demand are. On weekends in the spring and summer demand will exceed supply most of the time. During the winter diving activity decreases. At these times we don't know precisely when the parking lot will fill up or when the limit of scuba divers will be met, thus necessitating the use of a rationing system. Consequently, in order to achieve an equitable allocation throughout the year any system must be operating at all times.

Of course the key to having a successful system of allocation is being able to ensure that all the participants abide by the system. In other words, we must have the ability to enforce the rules. Ultimately, if

there is no enforcement, any system will be only partially successful at best.

PROPOSED SYSTEM TO ALLOCATE USE OF ALEXANDER SPRINGS AMONG SCUBA DIVERS

Supply of the Springs & Number of Divers

It is recommended that the Forest Service set the maximum number of divers allowed to enter the Alexander Springs Recreation Area at 45 divers at one time. Based on the size of the springs, the impacts on water quality of large number of divers, protection of the springs, and safety, this is a reasonable number of divers to allow to have access to the springs at one time. The limit of 45 divers includes all divers, those participating in classes as students and instructors as well as independent pleasure divers. The maximum number of divers participating in open water instruction at one time should be 36 divers, 3 groups of 12 divers, with each group consisting of 10 students, one instructor and one assistant. These numbers are equal to the supply of high quality diving experience which can safely be accommodated by the physical characteristics of Alexander Springs.

Allocation

Scuba divers will be notified by a sign at the gatehouse that they must show their certification card in order to dive in Alexander Springs. People who do not have

a certification card in their possession will not be allowed to dive unless they are participating in a class. Instructors must provide a list of the people in their class to the gatehouse attendant when they enter the area.

Use of the springs by diving classes will be allocated by use of a reservation system. Reservations will be made by calling the gatehouse during regular business hours no more than two weeks in advance. Each dive shop or instructor may make reservations for up to 30 students at a time. More than one instructor may schedule a class in each instruction period as long as the total number of divers participating in instruction does not exceed 36. There will be two instruction periods available for reservation each day, one in the morning from 8:00 a.m. to 12:00 noon and one from 12:00 noon to 4:00 p.m. all year.

Because of the additional administrative work load, the impact on the site, and the unique nature (special use of the resource) of scuba diving, it is recommended that the Forest Service establish a system of scuba diving user fees. The amount of the fee for diving should be determined by a survey of other springs in Florida where divers are allowed to dive. People paying the scuba diving user fee would not be charged the user fee for swimming.

During the hours when the gatehouse is staffed, the

attendent will issue a uniquely colored and marked receipt indicating the scuba user fee has been paid. Divers in classes will have their receipts marked with a large "C". Independent divers will have their receipts marked with a large "I". When the gatehouse is closed, scuba divers will be instructed by a sign on the fee board that they should pay the scuba user fee by use of the self service fee system.

The number of independent divers allowed access to the springs will be determined by the number of divers participating in classes. The number of independent divers will be 45 minus the number of people participating in instruction. Under this system a situation could arise which would allow more than 45 divers to gain access to the springs at one time. If a class with ten people comes into the area in the morning and 35 independent divers are also allowed to enter, there would be a total of 45 divers present during the morning hours. If a class with 30 people had the afternoon period reserved and all 35 independent divers stayed all day, there would be a total of 65 divers present during the afternoon period. The probability that this situation will arise is not very great. If it did occur, it is not likely that all divers would be in the water at the same time. Even though there would be more than 45 divers with access to the springs at one time, this temporary situation is tolerable from time to time.

Enforcement

Any system will be less than 100% effective unless it can be enforced. The primary enforcement for the proposed system will be provided by controlling access at the gate. However, this relies on people being honest enough to make it known that they are going to be scuba diving. Without doubt, there will be those who do not admit at the gatehouse that they are going diving. This is why it will be necessary for all divers to show their receipt to the lifeguard, when one is on duty, before entering the water. At times of the year when a lifeguard is not on duty, a Forest Service law enforcement officer should plan to visit the springs around 8:00 - 8:30 a.m. and again at 12:00 - 12:30 p.m. to check the divers' compliance with the system described above.

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APPEDNIX A

Scuba Information Survey Form

SCUBA INFORMATION SURVEY

1. List the sites you have used in the last year or so to conduct SCUBA classes. Please list them in descending order of frequency of use with the most often used site at the top of the list and the least used site at the bottom.

a. f.

b. g.

c. h.

d. i.

e. j.

2. What is it about site (a) above that makes it so attractive? Indicate the most important factor by placing a "1" next to it. Then rate the other factors in descending order of importance.

_____a. Proximity (distance from your place of business).

_____b. Convenience (lack of regulations or requirements of the site managers).

_____c. Fees (lack of or relatively low).

_____d. Reliability (you can always count on getting access to the site).

_____e. Aesthetic qualities (the overall look and feel of the site is pleasant to be around).

_____f. Facilities (showers, bathrooms, snack bars, nature trails, parking, shelters, etc.).

_____g. Water quality and other aquatic characteristics (clarity of the water, aquatic vegetation, fish, etc.).

_____h. Other qualities -

3. How many SCUBA classes do you conduct each week or month? Please indicate the average size of your classes.

a. Jan. - March: _____ classes per week/month.
_____ students per class.

b. April - June: _____ classes per week/month.
_____ students per class.

c. July - Sept.: _____ classes per week/month.
_____ students per class.

d. Oct. - Dec. : _____ classes per week/month.
_____ students per class.

4. On what days of the week do you most frequently conduct classes? Indicate the most frequent day by placing a "1" next to it. Then rate the other days in descending order of frequency.

_____a. Monday

_____b. Tuesday

_____c. Wednesday

_____d. Thursday

_____e. Friday

_____f. Saturday

_____g. Sunday

5. Do you believe the demand for sites to conduct SCUBA lessons is:
(Place an "X" next to the trend you think is occurring.)

_____a. Increasing

_____b. Decreasing

_____c. Steady

6. Do you believe the supply of sites to conduct SCUBA lessons is:
(Place an "X" next to the trend you think is occurring.)

_____a. Increasing

_____b. Decreasing

_____c. Steady

7. Please provide any other information you think pertains to the subject at hand. Feel free to write on the back of this page or use additional sheets of paper.

Mitchell H. Cohen
U.S. Forest Service
1551 Umatilla Road
Eustis, FL 32726
904 357-3721

February 9, 1987

Addressee:

By way of introduction, I am the Supervisory Forester on the Seminole Ranger District of the Ocala National Forest. One of the things that come under my area of responsibility is management of the special uses of the forest by the public. This includes the use of Alexander Springs to conduct SCUBA lessons.

Last fall I attended a three week recreation management course at Clemson University in South Carolina (the Professional Development for Outdoor Recreation Management Program). Part of that course is a home project. The project is to be directed at some aspect of recreation management which the participants in the program deal with in the course of their regular duties on the job. My project is directed at developing a better way to allocate the use of Alexander Springs to the SCUBA diving community. Enclosed is a copy of the prospectus which describes the problem and the project in more detail and what the specific objectives and goals are.

Now, why am I writing you? I need your help in getting a better understanding of the supply and demand situation pertaining to the suitable sites for SCUBA instruction in Central Florida and the pressures being put on these sites. It will be extremely helpful to me in completing this project and in the long run it will be very beneficial to you to give me your input and suggestions. Please take a few minutes to provide the information requested in the enclosed SCUBA Information Sheet. Naturally, your participation is voluntary. So I am relying on your professionalism and concern for protecting some of our non-renewable natural resources, the springs of Central Florida.

Please return the information sheet in the enclosed, self-addressed, stamped enveloped by February 21, 1987. If you have any questions about the project please call me at 904 357-3721. I will be glad to discuss the situation with you. Your input will have a direct effect on the conclusions which will be arrived at and the recommendations that will be made to the decision makers in the Forest Service in managing the use of Alexander Springs for SCUBA diving.

Yours truly,

Mitchell H. Cohen

APPENDIX B

Summary of Survey Results

Table 1. Most frequently used sites for open water SCUBA classes.

Site	No. of respondents using site.
Alexander Springs	8
Crystal River (King Springs)	8
Troy Springs	4
West Palm Beach, Fla.	4
Florida Keys	4
Ginnie Springs	3
DeLeon Springs	3
Lake Denton	2
Jupiter, Fla.	2
Blue Springs	2
Crystal Springs (Zepherhills)	1
Silver Glenn Springs	1
Blue Hole	1
Sun Springs	1
Manatee Springs	1
Forty Fathom Grotto	1
Private Lake (Deltona)	1
Miami, Fla.	1
Bimini	1
Bonaire	1
Bradenton Beach	1
Ward Sink	1

Table 2. Factors important to SCUBA instructors in selecting a site for open water classes.

Rating	1	2	3	4	5	6	7	8		
Weight factor	8	7	6	5	4	3	3	1		
FACTORS									Score	Ranking
Water Quality	2	2	2	1	1				51	1
Reliability	1	2	3	1			1		48	2
Proximity	2	1		1		1	3		37	3
Convenience	2				3	2	1		36	4
Aesthetics		2	2	2		1		1	35	5
Fees		1		1	3	2		1	31	6
Facilities				2	1	2	3		27	7
Other	1		1					6	20	8

Table 3. Instructor's perception of supply and demand for sites to conduct open water SCUBA classes.

SUPPLY			DEMAND		
Increasing	Decreasing	Steady	Increasing	Decreasing	Steady
1	9	2	11	0	1

Table 4. Seasonal demand for scuba instruction sites by scuba classes.

INSTRUCTOR		Jan.-Mar.			Apr.-June			July-Sept.			Oct.-Dec.		
		C	S	T	C	S	T	C	S	T	C	S	T
Dive Tech:	C	1			2			4			2		
	S		8			8			8			8	
	T			8			16			32			16
Hal Watts:	C	3			6			9			2		
	S		10			10			10			10	
	T			30			60			90			20
Scuba World III:	C	6			8			10			6		
	S		10			10			10			10	
	T			60			80			100			60
Deep Six:	C	1			2			5			2		
	S		8			10			10			8	
	T			8			20			50			16
Green Turtle:	C	1			1			1			1		
	S		9			9			9			6	
	T			9			9			9			6
SUB-TOTAL		12	-	115	19	-	185	29	-	281	13	-	118

C=Classes/mo. S=Students/class T=Students/mo.

(Table 4 continued on next page.)

Table 4. Continued. Seasonal demand for scuba instruction sites by scuba classes.

INSTRUCTOR		Jan.-Mar.			Apr.-June			July-Sept.			Oct.-Dec.		
		C	S	T	C	S	T	C	S	T	C	S	T
Dive & Tour:	C	2			4			4			2		
	S		6			6			6			6	
	T			12			24			24			12
Aquifer:	C	1			1			1			1		
	S		6			6			6			6	
	T			6			6			6			6
Richard Hutchinson:	C	1			1			1			1		
	S		2			4			2			2	
	T			2			4			2			2
Eustis Dive:	C	3			4			4			4		
	S		4			4			4			4	
	T			12			16			16			16
Carrollwood:	C	1			2			2			2		
	S		10			14			14			14	
	T			10			28			28			28
SUB-TOTAL		8	-	42	12	-	78	12	-	76	10	-	64
GRAND TOTAL		20	-	157	31	-	263	41	-	357	23	-	182

C=Classes/mo. S=Students/class T=Students/mo.

APPEDNIX C

Present Allocation System

EXHIBIT I

GUIDELINES FOR CONDUCTING SCUBA TRAINING
At The
ALEXANDER SPRINGS DAY USE AREA

To conduct open water Scuba training at Alexander Springs Day Use Area, one must:

1) Have a current Special Use Permit

2) Have the required insurance

3) Have a list of instructors and students in attendance

4) Have the necessary emergency telephone numbers

5) Have a reservation.

   a. Reservations are to be made no more than 15 days in advance of training.

   b. From March 15 to September 30, no reservations will be accepted for Sundays and holidays. On Saturdays and weekdays, reservations will be taken for no more than thirty (30) **students** in the morning and another group of no more than thirty (30) **students** in the afternoon. The same school cannot reserve both the morning and afternoon periods. The limit of thirty **students** does not include instructors. You may have thirty **students** plus instructors.

   c. From October 1 to March 14, reservations will be taken for a maximum of sixty (60) **students** any day of the week. There is no need for morning or afternoon reservations.

   d. To make reservations call the Alexander Springs Gatehouse at 904/669-3522.